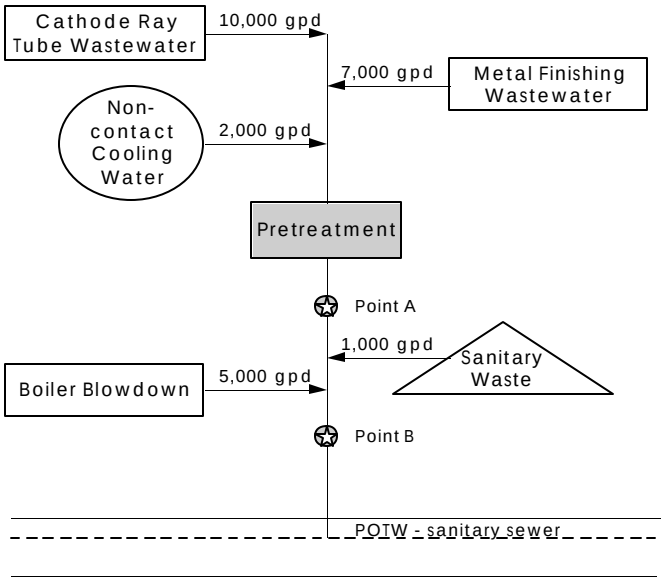
Solutions to Exercise 2 - Applying Pretreatment Standards



Exercise 2.

The calculations require proper identification (i.e, dilute, unregulated, or regulated) and flow rates for the various wastestreams. The regulated flow consists of 10,000 gpd from the manufacture of electronic components, 7,000 gpd from the metal finishing process. The dilution flow prior to pretreatment consisted of 2,000 gpd of noncontact cooling waters. The dilution flow after pretreatment consists of 1,000 gpd of sanitary wastewater. The total flow after pretreatment (at Point B) also includes 5,000 gpd of boiler blowdown which is considered an unregulated wastestream for zinc and a dilute wastestream for all other pollutants. Since this wastestream was not run through treatment to gain the environmental advantage of removing the higher levels of zinc, we **do** segregate this on a pollutant by pollutant basis.

At Point A, the CWF is used to calculate the adjusted concentration limit for all pollutants. Then, for all pollutants at Point B, the Flow Weighted Average is used to determine adjusted limits. For zinc at Point B, limits are also calculated by the CWF and then the more stringent approach used to determine the limit to be imposed.

Calculations are shown for daily maximum zinc limits and answers are provided for all pollutants in the table following the calculations.

Calculation for Zn Daily Maximum Limitation:

First, an alternate limit will be calculated using the CWF at Point A.

$$Zn_{cwfa} = \frac{(Zn_{ec} * F_{ec}) + (Zn_{mf} * F_{mf})}{F_{ec} + F_{mf}} * \frac{F_a - F_{da}}{F_a}$$

Where:

Zn_{cwfa} = Adjusted zinc limit using the CWF at Point A, mg/l
Zn_{ec} = Electrical and Electronic components PSES, mg/l
Zn_{mf} = Metal finishing PSES, mg/l
F_{ec} = Electrical and electronic components process flow, gpd
F_{mf} = Metal finishing flow, gpd
F_{da} = Dilution flow combined prior to point A
F_a = Total flow at Point A ($F_{mf} + F_{ec} + F_{da}$), gpd

$$\mathbf{Zn_{cwfa}} = \frac{(1.38 \text{ mg/l}) * 10{,}000 \text{ gpd}) + (2.61 \text{ mg/l} * 7{,}000 \text{ gpd})}{7{,}000 \text{ gpd} + 10{,}000 \text{ gpd}} * \frac{19{,}000 \text{ gpd} - 2{,}000 \text{ gpd}}{19{,}000 \text{ gpd}}$$

$$= \frac{(18{,}270 \text{ mg(gpd)/l} + 13{,}800 \text{ mg(gpd)/l})}{17{,}000 \text{ gpd}} * \frac{17{,}000 \text{ gpd}}{19{,}000 \text{ gpd}}$$

$$= \frac{32{,}070 \text{ mg(}\cancel{\text{gpd}}\text{)/l}}{17{,}000 \ \cancel{\text{gpd}}} * \frac{17{,}000 \ \cancel{\text{gpd}}}{19{,}000 \ \cancel{\text{gpd}}}$$

= **1.69 mg/l**

To calculate the zinc limit at Point B, a flow weighted average formula is used to account for nonregulated wastestreams which consist of unregulated (boiler blowdown for zinc at 5,000 gpd) and dilute wastestreams (boiler blowdown at 5,000 gpd for other pollutants, and sanitary wastes at 1,000 gpd for all pollutants). The FWA formula is used to calculate alternative limits when wastestreams are combined following pretreatment.

$$Zn_{fwab} = \frac{(Zn_a * F_a) + (Zn_{ur} * F_{ur}) + (Zn_d * F_d)}{F_b}$$

Where:

Zn_{fwab} = Alternate zinc limit using the FWA at Point B, mg/l

Zn_a = Adjusted zinc limit using the CWF at Point A, mg/l

F_a = Total flow at Point A ($F_{mf} + F_{ec} + F_{da}$), gpd

Zn_{ur} = Zinc in unregulated wastestream (boiler blowdown) after pretreatment but prior to Point B, mg/l

F_{ur} = Flow of unregulated wastestream (boiler blowdown) after pretreatment but prior to Point B, gpd

Zn_d = Zinc in dilute wastestream (sanitary wastes) after pretreatment but prior to Point B, mg/l

F_d = Flow of dilute wastestream (sanitary wastes) after pretreatment but prior to Point B, gpd

F_b = Total flow at Point B, gpd

$$\mathbf{Zn_{fwab}} = \frac{(1.69 \text{ mg/l} * 19{,}000 \text{ gpd}) + (4.0 \text{ mg/l} * 5{,}000 \text{ gpd}) + (0 \text{ mg/l} * 1{,}000 \text{ gpd})}{(19{,}000 + 5{,}000 + 1{,}000) \text{ gpd}}$$

$$= \frac{(32{,}110 \text{ mg(gpd)/l} + 20{,}000 \text{ mg(gpd)/l} + 0 \text{ mg(gpd)/l})}{25{,}000 \text{ gpd}}$$

$$= \frac{52{,}110 \text{ mg(}\cancel{\text{gpd}}\text{)/l}}{25{,}000 \ \cancel{\text{gpd}}}$$

= **2.08 mg/l**

Next, an alternate limit will be calculated using the CWF at Point B:

$$Zn_{cwfb} = \frac{(Zn_{cwfa} * F_{cwfa}) + (Zn_{urb} * F_{urb})}{F_{cwfa} + F_{urb}} * \frac{F_b - F_{db}}{F_b}$$

Where:

Zn_{cwfb} = Alternate zinc limit using the CWF at Point B, mg/l
Zn_{cwfa} = Alternative zinc limit calculated at Point A, mg/l
Zn_{urb} = Zinc amount in unregulated boiler blowdown, mg/l
F_{cwfa} = Flow at Point A, gpd
F_{db} = Dilution flow at Point B
F_{urb} = Unregulated flow at Point B
F_b = Total flow at Point B ($F_{cwfa} + F_{urb} + F_{db}$), gpd

$$\mathbf{Zn_{cwfb}} = \frac{(1.69 \text{ mg/l} * 19{,}000 \text{ gpd}) + (4.0 \text{ mg/l} * 5{,}000 \text{ gpd})}{(19{,}000 + 5{,}000)\text{gpd}} *$$

$$\frac{(19{,}000 + 5{,}000 + 1{,}000) \text{ gpd} - (1{,}000) \text{ gpd}}{(19{,}000 + 5{,}000 + 1{,}000) \text{ gpd}}$$

$$= \frac{(32{,}110 \text{ mg(gpd)/l} + 20{,}000 \text{ mg(gpd)/l})}{24{,}000 \text{ gpd}} * \frac{24{,}000 \text{ gpd}}{25{,}000 \text{ gpd}}$$

$$= \frac{52{,}110 \text{ mg(}\cancel{\text{gpd}}\text{)/l}}{24{,}000 \cancel{\text{gpd}}} * \frac{24{,}000 \cancel{\text{gpd}}}{25{,}000 \cancel{\text{gpd}}}$$

Zn_{cwfb} = **2.08 mg/l**

Since the CWF alternate limit at Point B (2.08 mg/l) and the FWA alternate limit at Point B (2.08 mg/l) are the same in this case, either could be used as the alternate limit for the zinc daily maximum. Since the FWA must be used for the other pollutants at Point B, it seems logical to use the FWA for the zinc limit as well. However, this alternate limit, as well as alternate limits for other pollutant parameters must be compared against any local limits established. For zinc, the alternate daily maximum categorical pretreatment standard for zinc (2.08 mg/l) is more stringent than the local limit (2.50 mg/l). Since there are no local limits for monthly average for zinc, the Federal limits are more stringent.

The following table details the alternate categorical pretreatment standards for all regulated pollutants and compares them with the local limits. The last column shows the limit that will apply in the facility's permit if Point B is the monitoring and control point.

	Imaginary Point A (mg/l) CWF adjusted categorical pretreatment standards		**Point B (mg/l) FWA adjusted categorical pretreatment standards**		**Local Limit (mg/l)**	**Permit Limit (mg/l) (Point B)**	
Pollutant	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Daily Maximum**	**Monthly Average**
Cadmium	0.29	0.11	0.22	0.08	0.45	0.22	0.08
Chromium	1.36	0.79	1.03	0.60	2.50	1.03	0.60
Copper	3.02	1.85	2.30	1.41	2.05	2.05	1.41
Lead	0.84	0.37	0.64	0.28	0.50	0.50	0.28
Nickel	3.56	2.13	2.71	1.62	4.00	2.71	1.62
Silver	0.38	0.21	0.29	0.16	1.65	0.29	0.16
Zinc	1.69	0.84	2.08	1.44	2.50	1.66	1.44
Cyanide, T	1.07	0.58	0.81	0.44	1.00	0.81	0.44
Cyanide, A	0.77	0.29	0.58	0.22	No limit	0.58	0.22
TTO	1.62	No limit	1.23	No limit	No limit	1.23	No limit
Fluoride	31.3	16.1	23.8	12.2	No limit	23.8	12.2